MEPAG 2012 Goal III update

Based on incorporation of new analysis from the P-SAG

Draft for community review.

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IIIA-7. Investigation: Determine the present activity, tectonic history, and large-scale vertical and horizontal structure of the crust~~, including present activity~~. This includes, for example, the structure and origin of hemispheric dichotomy.

Understanding the natural seismicity, tectonic record, and the structures within the crust over large vertical and horizontal scales is crucial for understanding the geologic history as well as the temporal evolution of internal processes. This, in turn, places constraints on release of volatiles from differentiation and volcanic activity and the effect of tectonic structures (faults and fractures in particular) on subsurface hydrology. Determining these structures would require gravity data, deep subsurface sounding (100~~'~~s of meters to kilometers), detailed geologic and topographic mapping (including impact mapping/studies), and determination of the compositions of major geologic units. Because the present level of seismicity on Mars is essentially unknown, a single well-installed seismic station would be of great value as a "pathfinder" for a full network, providing distance to and level of seismicity, and character of seismic signals and noise in this unexplored environment. The accurate localization of marsquakes in space and time provided by a~~A~~ long-term, continuously active seismic network composed of multiple stations would be required to fully understand the distribution and intensity of current tectonic activity.

IIIB-1. Investigation: Characterize the structure and dynamics of the interior.

Understanding the structure and dynamical processes of the mantle and core is fundamental for understanding the origin and evolution of Mars, its surface evolution, and the release of water and atmospheric gas~~s~~es. For example, the thickness of the crust and the size of the core provide strong constraints on the bulk composition of the planet, its thermal history, and the manner in which it differentiated. This investigation would require seismology (e.g., passive and active experiments and understanding of the seismic state of the planet), heat flow, ~~and~~ gravity data, precision tracking for rotational dynamics, and electromagnetic sounding. Because accurate localization of seismic activity is necessary to fully address all objectives, at least four stations operating simultaneously for a full Mars year are required. However, progress in this investigation could be made with a single station. There are a number of techniques available for using single-station seismic, heat flow, and precision tracking data to obtain key information on interior structure and processes. Interpretation of such data would depend on models and assumptions, and the results would be biased toward a single region of the planet. But given the nearly complete lack of data on the Martian interior, results from a single station would represent a significant advance.